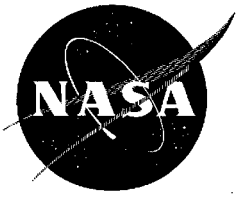
The signature page of the WORF Project Plan is currently in the JSC ISS Program Office awaiting signature.

WORF Project Plan

International Space Station Program

February 2001

National Aeronautics and Space Administration
Marshall Space Flight Center



REVISION AND HISTORY PAGE

REV.	DESCRIPTION	PUB. DATE

WORF Project Plan

Signature Sheet

JULY 2000

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Project Plan

For the International Space Station (ISS)

Window Observational Research Facility Project

1.0 INTRODUCTION

This plan defines the implementation of the WORF Project within the Multi-use Payloads Group at Marshall Space Flight Center. It includes the WORF hardware development and payload integration. It also documents all needed ISS hardware, both flight and ground equipment.

The purpose of this plan is to impart the mechanism to plan, organize and staff, direct and lead, and control the WORF Project, including the mission description, programmatic, and technical and management approach. Included in the plan are approaches for resources and schedules control. Detailed technical requirements will be included in other project documentation.

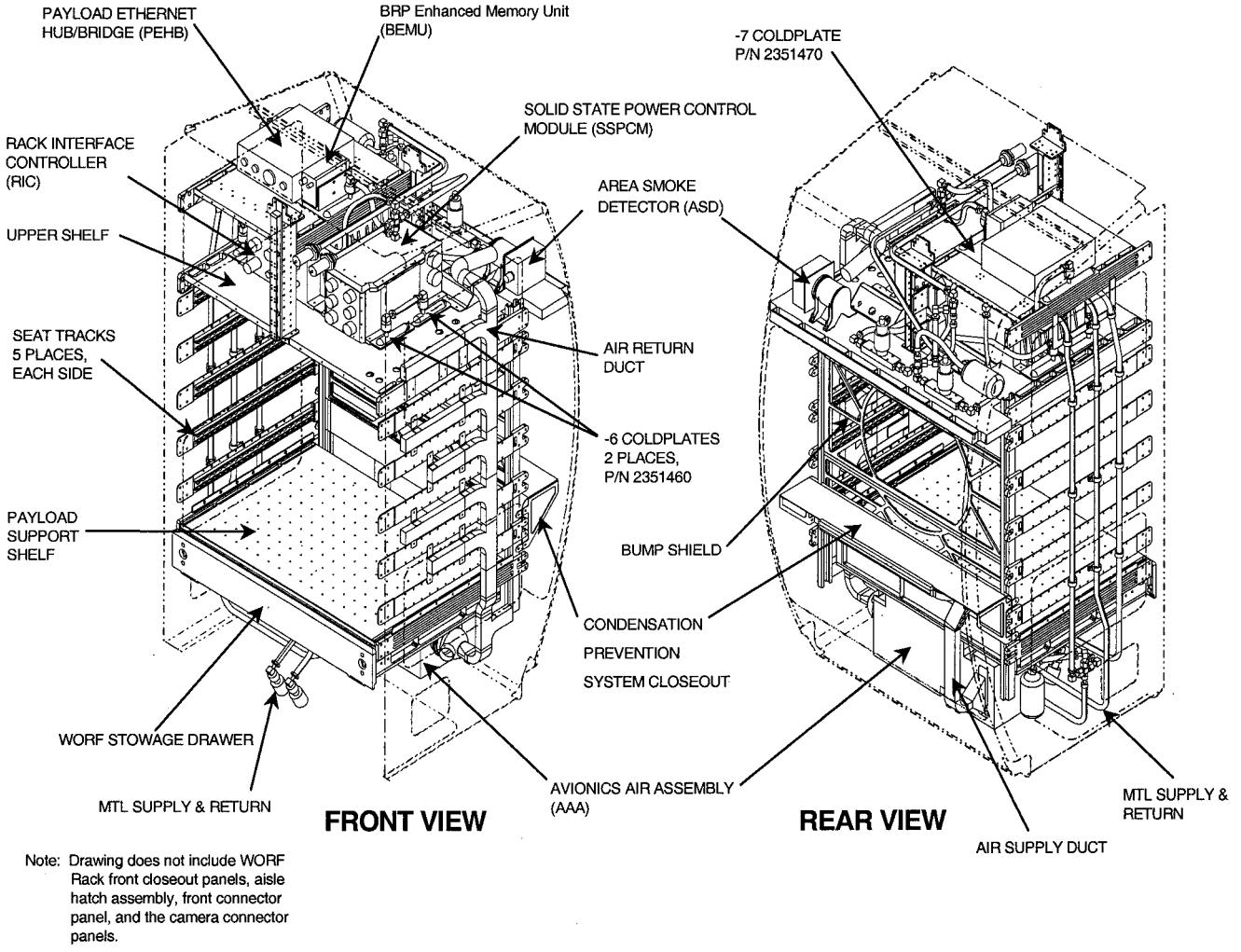
1.1 PROJECT OVERVIEW

The Window Observational Research Facility (WORF) provides a stable platform for payloads that utilize the International Space Station (ISS) United States Laboratory (U.S. Lab) nadir research window. The WORF Rack is based on the standard EXpedite the PRocessing of Experiments to the Space Station (EXPRESS) Rack. However, the WORF mechanical interfaces for payloads are substantially different. WORF includes standard mounting interfaces and access to U.S. Lab utilities to accommodate simultaneous operation of up to two payloads. The facility will also support crewmembers conducting Earth observation activities by providing interfaces for mounting payloads such as restraints and an adjustable bracket for mounting still cameras and camcorders. Payload Developers (PD) can choose between a number of operational configurations including crew-occupied and completely autonomous modes. (Reference Figure 1.1-1)

The WORF hardware will be developed to meet the intent of payload facility class requirements, as defined in SSP 50431. Hardware life expectancy is predicted as 10 years, and the facility design approach will allow recovery from failures through in-flight servicing and maintenance.

The Multi-use Payloads Group will build WORF trainers for crew training. The WORF Ground Rack will be provided for the Space Vehicle Mock-up Facility (SVMF) to support hands-on training of the WORF. The WORF Integrated

Trainer will be provided for the Space Station Training Facility/Payload Training Capability (SSTF/PTC) to support integrated training of the WORF and payloads.



Note: Drawing does not include WORF Rack front closeout panels, aisle hatch assembly, front connector panel, and the camera connector panels.

FIGURE 1.1-1 WORF

A Suitcase Simulator will be provided by the Multi-use Payloads Group for payload developers' use in the development and checkout of their payload to WORF data interfaces.

The WORF will operate in the International Space Station (ISS) United States Laboratory (U.S. Lab) nadir research window position. It provides a facility whereby the U.S. Lab nadir viewing research window can be utilized for Earth and space science research.

2.0 OBJECTIVES

The objective of the WORF Project is the safe design, fabrication and integration, and maintenance of a payload rack for use in performing Earth and space science research on the International Space Station (ISS).

The project goal is to provide standard accommodations and services for subrack science payloads, which will allow them to access the unique research capabilities of the U.S. Lab nadir research window.

The WORF Project fits within the implementation of the overall ISS program objective and goals, to develop a space-based platform for the performance of scientific research.

2.1 PRIMARY PERFORMANCE GOALS

- Provide structure for which hardware can be rigidly attached
- Provide stowage
- Protect the window port
- Protect window optical quality
- Accommodate crew utilization of the WORF
- Provide window access
- Provide access to ISS utilities located at the LAB1 D3 position

3.0 MANAGEMENT

3.1 ORGANIZATION & RESPONSIBILITIES

Program Management: The ISS Payloads Office (OZ1) located at Johnson Space Center (JSC) is responsible for program management (budget, schedules and any level A requirements) of the WORF Project.

Project Management: Project management resides in the Pressurized Payloads Team of the Multi-use Payloads Group within the MSFC Flight Projects Directorate. The Project will be implemented by Boeing Defense and Space Group under Contract NAS8-50000 with the MSFC. The NAS8-50000 contract is a cost-plus award fee contract. The responsible Governing Project Management Council (GPMC) is located at Marshall Space Flight Center.

The Multi-use Payloads Group at MSFC is organized into product teams. One of these product teams is the WORF Project located within the Pressurized Payloads Team. The WORF Project Team includes both rack development and engineering integration and is managed by the Multi-use Payloads Group Lead, who has overall responsibility for the WORF Project. The WORF Project organizational structure is shown in Figure 3.1-1. Boeing Defense and Space Group implements the WORF Project.

Rack development consists of design, development and verification of the WORF and support equipment. Rack development responsibility is accomplished by contractor sub-teams, which are responsible for the end item development. Engineering Integration covers integration of the WORF Payloads into the Rack, and interfacing the integrated Rack to the ISS Program.

The NASA System Engineer provides technical support and is responsible for providing and coordinating the support from the MSFC Engineering Directorate (ED).

The MSFC ED personnel will participate in design reviews, other periodic reviews and support the project, as required, in providing technical evaluations and recommendations, test support, operations and configuration management. The MSFC Safety and Mission Assurance Directorate supports the project in the areas of safety, quality assurance, reliability and maintainability. In addition, the MFSC quality assurance delegate monitors and approves the build up and testing of the Rack. The Flight Projects' Program Planning and Control Office supports the project through development of the project budget, submission of program operating plans and resource phasing plans, control of funding authority and associated tracking and reporting. The Multi-use Payloads Group has the final authority on all project decisions.

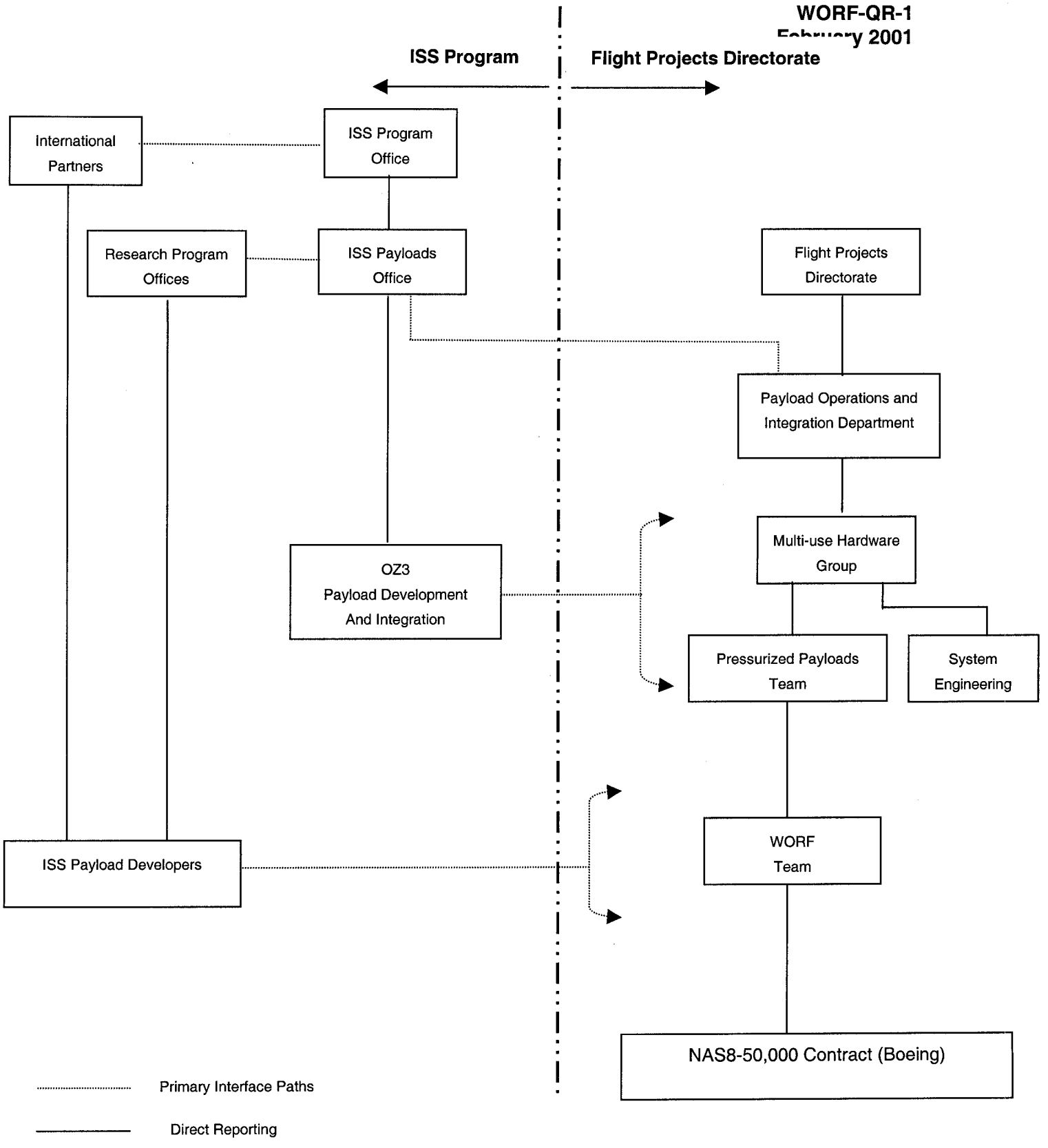


FIGURE 3.1-1 WORF PROJECT ORGANIZATION

3.2 CUSTOMER DEFINITION AND ADVOCACY

The primary Customers for the WORF hardware are:

- ISS Payloads Office
- ISS Payload Developers

Initial customer advocacy was performed through the ISS Payloads Office, which contained the primary customers or their representatives. This office established the initial WORF Requirements, which were included in the WORF Project Requirements Document (PRD). To validate the PRD requirements, a System Requirements Review (SRR) was conducted.

Contract Review (i.e. Customer Agreement) with the ISS Payloads Office, for the scope of the WORF Project, is achieved through the use of this Project Plan and the annual JSC Internal Task Agreement (ITA).

Customer participation is assured through several on going cross cutting processes. These include:

ISS Payloads Office: Monthly cost, schedule, technical reviews are held with the Payloads Office. The Payloads Office will provide a crew representative to work with the project as needed to resolve hardware development issues and conduct crew oversight. Hardware human factor reviews are performed using crew reviews of hardware. Display development reviews are conducted through the ISS Payload Display Review Panel process (which includes crew representatives).

ISS Payload Developers: Payload advocacy is maintained through periodic coordination telecons with payload users to discuss development and payload integration and operation issues. Each payload customer will be assigned to a WORF Payload Integration Manager (WPIM), who will work to identify and resolve payload accommodation issues between the project and payload teams. Payload requirement's documentation such as the payload Interface Definition Document (IDD) and generic Payload Verification Plan (PVP) are controlled through a formal boarding process, where the payload customers are asked to provide inputs.

General: During the design phase of the project, all major customers will be requested to participate in the major design/development reviews of the project. Final advocacy is provided by the participation of all customers (or their representatives) in the ISS Payloads Control Board. Major technical and operations issues involving the project are discussed in this forum.

3.3 RELATIONSHIP TO OTHER PROGRAMS/PROJECTS

3.3.1 INTERNATIONAL SPACE STATION (ISS) PROGRAM

WORF Payload Projects

The WORF payloads will be developed separately under the management of commercial organizations, academic organizations, Research Program Offices, and the International Partners. The WORF Team will integrate these payloads into the WORF.

Related Payload Flight Facilities

The WORF Rack is a derivative of the standard EXpedite the PRocessing of Experiments to the Space Station (EXPRESS) Rack, redesigned to allow U.S. Lab window access through the center of the Rack. Other derivative racks include: The Space Station Biological Research Project (SSBRP), which utilizes a derivative of the all drawer EXPRESS for its Habitat Holding Racks (HHR); The Human Research Facility (HRF) Project utilizes an enhanced version of the all drawer EXPRESS.

The commonality between EXPRESS and these derivative Racks will simplify crew training, on-orbit operations, and subsystem sparing.

ISS Program Office: Primary Relationships

The Payloads Office within the ISS Program is responsible to provide Program Management of the WORF Project (development and payload integration).

The Payloads Office also performs the engineering integration of the WORF as a facility into the ISS. The integration activity includes software development and integration for the WORF Facility to the ISS data system. This activity is performed using documentation provided by WORF Engineering Integration.

The Payloads Office within the ISS Program is responsible for program management of ground processing of the WORF Rack. This activity is performed for the ISS Payloads Office by Kennedy Space Center, using the technical requirements and documentation provided by WORF Engineering Integration.

The Vehicle Office within the ISS Program is responsible for program management of the analytical and physical integration of the integrated WORF into the MPLM carrier. Kennedy Space Center performs the physical integration activity. Both activities are performed using technical requirements and documentation provided by WORF Engineering Integration.

Payload Operations and Integration Function (POIF)

Because of the multidiscipline mix of payloads to be integrated and operated in the WORF on the ISS, the operations approach planned is unique from the other ISS Facilities. The POIF team at MSFC has been delegated the responsibility to perform the operations integration of the WORF Payloads into the WORF, thereby allowing a more efficient integration of the Rack and payloads into the ISS timeline. Real time execution of the operations plan is performed by the POIF, with the WORF Team providing on call technical support. However, the WORF Team is responsible for ensuring that the technical and safety requirements of the WORF are maintained during operations.

4.0 APPLICABLE DOCUMENTS

ERO-QR-2	Multi-use Payloads Group Configuration Control Board (CCB) Charter
FPD-OI-FD30.1	Payload Operations and Integration Department FD30, Management Process
FD31-QAPLAN-01	MSFC Space Station Multi-use Payloads Group Quality Plan
KHB 1700.7B	Payload Ground Safety Handbook
MSFC-PLAN-3023	MSFC Space Station Multi-use Payloads Group Data Management Plan
MSFC-PLAN-3028	MSFC Space Station Multi-use Payloads Group Configuration Management Plan
MSFC-PLAN-3101	Pressurized Payloads Team Risk Management Plan
MPG 2190.1	MSFC Export Control Program
MPD 1280.1	Marshall Management Manual
MPG 7120.1	Program/Project Planning
NSTS 1700.7B	Safety Policy Requirements for Payloads Using the STS
NSTS 1700.7B (Add.)	Safety Policy Requirements for Payloads Using the International Space Station

NSTS 18798B	Interpretation Letters of NSTS/ISS Payload Safety Requirements
SSP 30223	Problem Reporting and Corrective Action System for the Space Station Program
SSP 50431	Station Program Requirements for Payloads

5.0 TECHNICAL SUMMARY

5.1 WORF DESCRIPTION

The WORF Project includes the design, development, manufacturing, and testing of the deliverable items shown in Table 5.1-1.

TABLE 5.1-1 WORF PROJECT DELIVERABLES

ITEM	QUANTITY
WORF Flight Rack	1
Ground Rack/Trainer	1
Integrated Trainer	1
Suitcase Simulator	1

5.2 HARDWARE SUBSYSTEM DESCRIPTION

WORF accommodations for payloads are shown in Table 5.2-1. The WORF Rack is a customized NASA ISPR specifically designed to provide a facility for Earth and space science research using the U.S. Lab nadir viewing science window. The rack is outfitted with selected EXPRESS Rack subsystems plus equipment unique to the needs of the WORF.

WORF provides power distribution and circuit protection for electrical power and the conversion of the ISS-provided 120V dc power to 28 V dc for the payloads through a Solid State Power Control Module (SSPCM). There are 1.9 kilowatts of 28Vdc power available to the total payload complement within the rack. The Rack Interface Controller (RIC) serves as a data router, interfacing with the ISS Command and Data Handling (C&DH) System and providing simple data interfaces (RS422, Ethernet, discrete, and analog) to each payload location. The RIC puts the payload data in packets, adds headers to identify the payload and transmits it over the ISS C&DH System. The RIC will also contain a Common Video Interface Card to convert the payload electrical baseband video signal (RS-170A) to a fiber optic pulse frequency modulated signal for

distribution to the ISS Internal Video System. The software to control the rack and to accommodate standard payload inputs is provided.

The rack subsystems components are coldplate-mounted and cooled by the ISS Thermal Control System moderate temperature loop in order to preserve air-cooling provided by the Avionics Air Assembly (AAA) for the payloads. The AAA also provides cooling and CO2 dispersion during crew operations in the payload volume. Liquid cooling, from the moderate temperature loop, is also available at two locations for payload use.

TABLE 5.2-1 WORF PAYLOAD ACCOMMODATIONS

Resource	Standard Accommodation
Structural/ Mechanical	up to 3 payloads Internally and 2 externally
Power	1900 Watts (W) 28 Volts (V) dc
Thermal	336W air & 500W water-cooling
Data	RS422, Ethernet, Analog, Discrete
Video	NTSC Interface

WORF includes a laptop for use as the on-orbit crew interface for the rack and the control and monitoring of the rack subsystems. The laptop is also used for controlling payloads and for configuring payload data and power interfaces on the rack.

WORF will be launched and remain on-orbit, where subrack payload exchanges will occur as needed.

The WORF Project will develop a Suitcase Simulator (ScS) for use in the development and checkout of payload data interfaces. The ScS will be located with the WORF Ground Rack/Trainer in the SVMF at JSC.

Two trainer racks will be built by the Multi-use Payloads Group to support WORF crew training. The WORF Ground Rack will be provided for the SVMF to support hands-on training of the WORF. The WORF Integrated Trainer will be provided for the SSTF/PTC to support integrated training of the WORF and payloads. The integrated trainer will be capable of interfacing with the PTC resources and accommodating payload trainers to support integrated training capability. Requirements for the WORF Integrated Trainer are documented in the Payload

Simulator Requirements Document (PSRD), Volume I, developed by the ISS Payload Training personnel.

The detailed schedule for the development and integration of the WORF hardware will be developed by the contractor within the major program milestone objectives. The project schedule will be defined based on the project's Functional Flow/Logic Network. Once developed, the schedule will be updated and maintained. A monthly meeting is planned to discuss issues and schedules. In addition weekly contact between NASA and Boeing team leads will be required. A summary milestone schedule for the project is shown in Figure 5.2-1.

Schedule analysis will be performed highlighting the critical path, areas behind schedule and problem identification. The schedule will allow high-level views of major milestones and more detailed views for more in-depth analysis.

WORF end item delivery schedules are controlled in the contract with design review and integration review dates for the WORF Project. Any changes to these must be negotiated and agreed to by the Multi-use Payload Group.

The key points of the project schedules will be loaded in the ISS Common Schedules Database (CSD) as required by SSP50431. Updates to the CSD will be provided monthly, as needed.

5.3 ENGINEERING INTEGRATION

Engineering Integration (EI) of WORF payloads into the WORF Rack will be performed by the Engineering Integration Team. Engineering Integration activities include:

Definition of the WORF payload integration template

Development of the WORF Payload Integration Handbook, which includes the WORF Integration Agreement, Payload Accommodations Handbook, Interface Definition Document, Payload ICD, Generic Payload Verification Plan, etc.

Guidance to individual WORF payload developers throughout the integration process--WORF Payload Integration Manager (WPIM) function

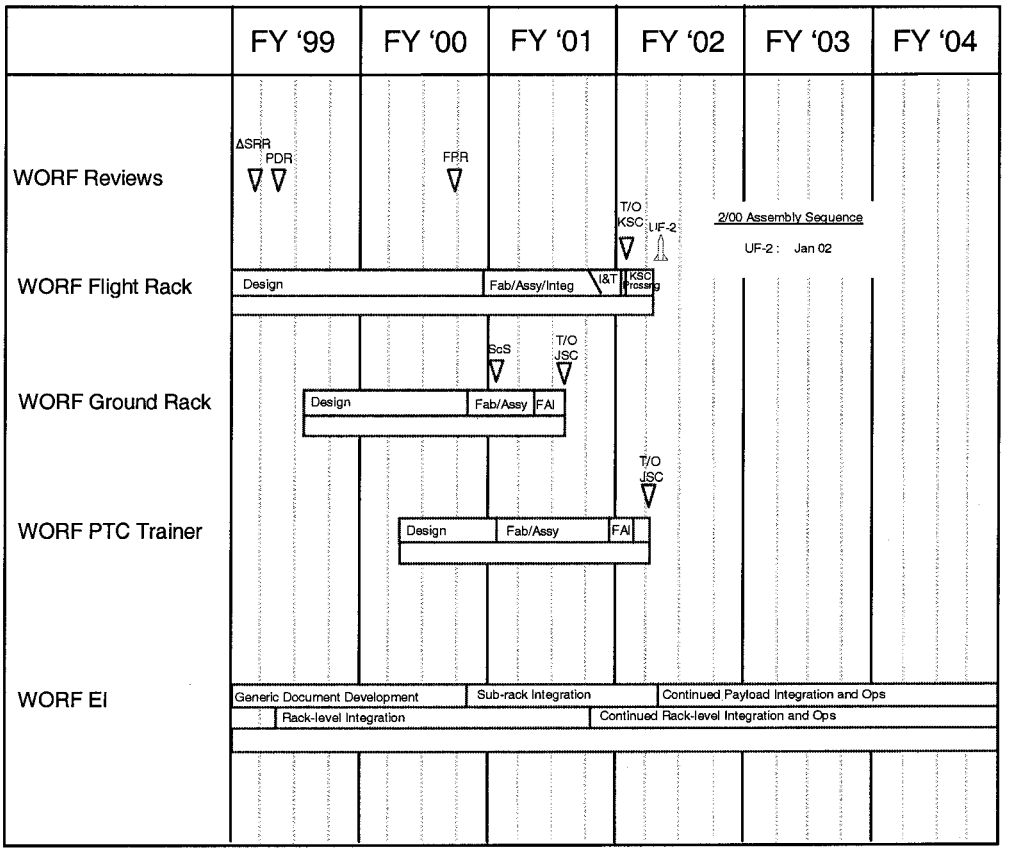
Compatibility analyses of WORF payload to WORF Rack and development of operational constraints

Integrated rack payload complement hazard analyses

Assembly and installation drawings for physical integration of payloads into the WORF

Integrated mechanical/electrical schematics for the rack

Definition of interface verification and checkout requirements for ground processing of the WORF Rack



	FY00	FY01	FY02	FY03	FY04	FY05	TOTAL
WORF Budget Runout	5.070	6.550	1.440	0.600	0.600	0.600	14.860

FIGURE 5.2-1 WORF MILESTONE SCHEDULE

5.4 GROUND/TEST SUPPORT EQUIPMENT AND FACILITIES

The WORF will be fabricated and tested at the MSFC using existing test equipment and facilities where possible. An ISS provided Payload Rack Checkout Unit (PRCU) will be used to verify ISS interface compatibility. The WORF will be tested to meet its performance, functional, interface, and environmental requirements at the MSFC.

The following GSE will be developed by the project:

- Suitcase Simulator (to test WORF Payload Data interfaces)

6.0 PROJECT IMPLEMENTATION APPROACH/TASK DESCRIPTIONS

6.1 REQUIREMENTS CONTROL

The Space Station Payloads Office developed a draft WORF Project Requirements Document (PRD) in December 1997 that was the basis for initiation of the WORF Project. This PRD was further defined in a Systems Requirements Review (SRR) and a delta SRR, and was baselined by the ISS Payloads Control Board in January 1999.

A Prime Item Development Specifications (B1 specifications) for each of the deliverable end items (i.e. WORF Flight Rack, Trainers, Suitcase Simulator) in the WORF Project was written and is controlled by the Multi-use Payloads Group Control Board. B2 specifications, or the contractor equivalent, will be prepared for each major avionics box and will be controlled by either the Multi-use Payloads Group Control Board or contractor. Where applicable, EXPRESS specifications may be used.

Upper tier ISS interface documents, such as the Interface Requirements Document (IRD), are included in the deliverable end items specifications. Programmatic requirements for facility payloads as defined in SSP 50431, Station Program Requirements for Payloads, were also included in the project. Compliance with SSP50431 is shown in Appendix C.

The WORF requirement tree is shown in Figure 6.1-1.

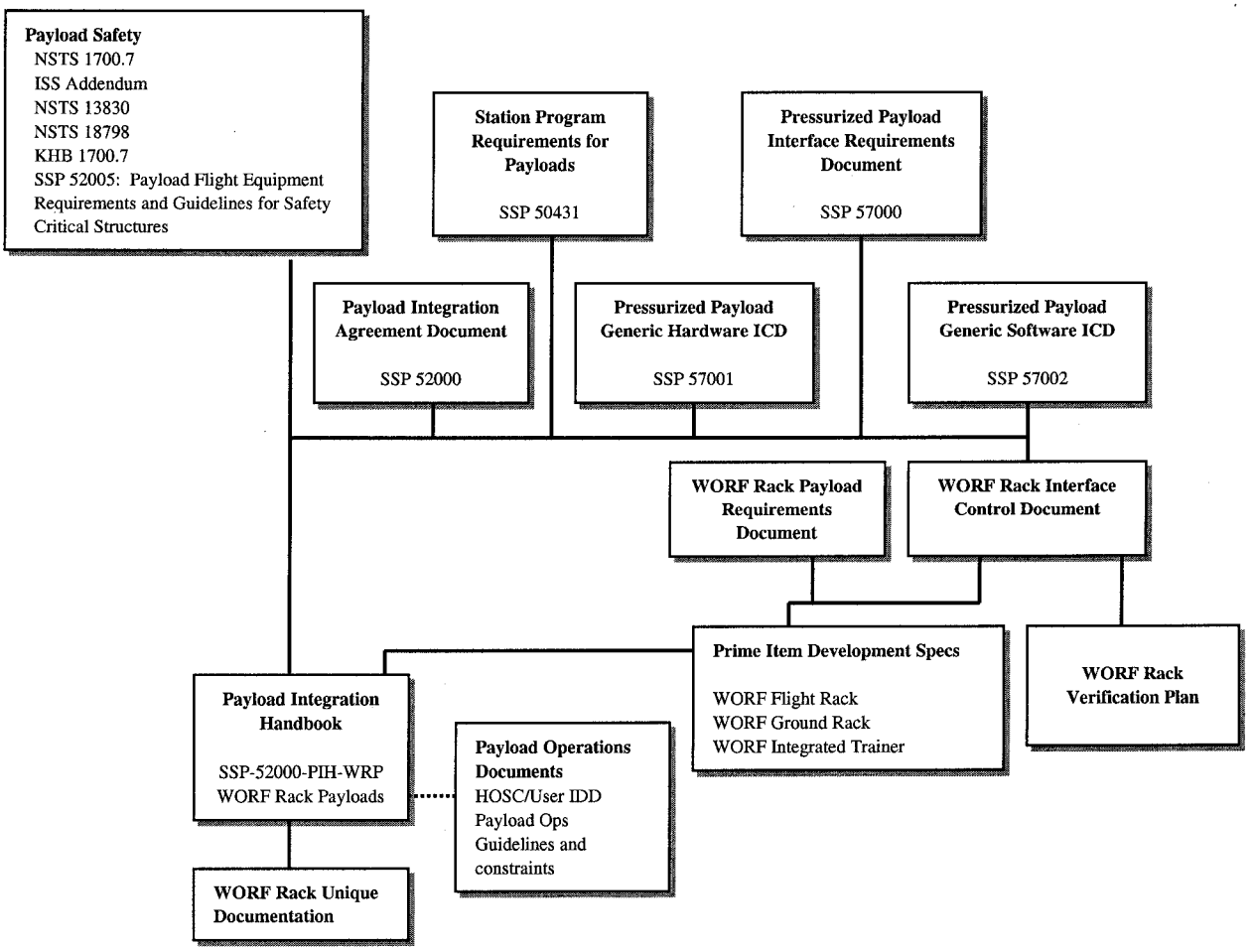


FIGURE 6.1-1 WORF REQUIREMENTS

6.2 CONFIGURATION MANAGEMENT

The configuration management of WORF Project will be conducted per the MSFC Space Station Multi-use Payloads Group Configuration Management Plan and established MSFC CM policy. WORF related changes, deviations, and waivers to Government controlled documents will be processed in accordance with the plan and MSFC Configuration Management Procedures. The WORF Project will prepare changes to formally baselined documentation, as required.

Deviations and waivers to ISS controlled requirements will be submitted to the SSPO for processing.

The WORF Project is responsible for the preparation of an Acceptance Data Package (ADP) for each WORF Configuration End Item. The ADPs for WORF Configuration Items at the End Item level (WORF Flight Rack, Trainers, ScS) will be prepared by the contractor and approved by the Multi-use Payloads Group Manager. The ADP will provide MSFC with the documentation necessary to determine the acceptability of the delivered item. The ADP will accompany the WORF item at delivery.

6.2.1 DRAWING CONTROL

All drawings utilized by this project to fabricate, assemble, or test the WORF hardware will be placed under configuration control as specified in MSFC-PLAN-3028, MSFC Space Station Multi-use Payloads Group Configuration Management Plan.

6.2.2 QUALITY RECORDS

Quality records are evidence that satisfies the requirements of the MSFC Quality Systems. These records will show compliance to requirements and specifications. The records can be electronic or hardcopy.

The project will identify quality records in accordance with FPD-OI-FD30.1. The records will contain unique project identifiers and will be filed in a designated location.

6.3 BOARDS AND MANAGEMENT SUPPORT

6.3.1 CONFIGURATION CONTROL BOARDS

The WORF Configuration Management process is described in the Multi-use Payloads Group Configuration Management Plan (MSFC-PLAN-3028).

ISS Payloads Control Board

The ISS Payloads Control board is a level-2 board operating in the ISS Program Office at JSC. This board is chartered to address major technical, cost, schedule, and operations issues related to payload development and operation on the ISS. The Flight Projects Directorate will provide a representative to serve as the FPD member of this control board. Through this membership, WORF Project provides data, technical assessments, and identifies process issues to the ISS Payloads Office. Project documentation requiring Level 2 control will be managed at this board. (Reference Figure 6.1-1)

Multi-use Payloads Group Control Board

The Multi-use Payloads Group Control Board is a level-3 board operating in the Multi-use Payloads Group at MSFC as defined in ERO-QR-2. This board is chartered to control group documentation related to hardware development,

payload integration, and operation on the ISS. The board is chartered through the ISS Payloads Office.

The Engineering Directorate Configuration Management Group maintains the CCB membership listing for the board.

Material Review Board (MRB)

This Project MRB is responsible for assessing and dispositioning of all referred nonconformances to applicable drawings, specifications, test or other requirements.

A System Engineering representative, or specified delegate, and a NASA Quality representative, or specified delegate, will be members of the contractor's project MRB. The MRB will review and disposition issues in accordance with the NAS8-50000 contract. If it is determined that Class I change criteria is affected, a Deviation Approval Request (DAR) will be processed.

6.4 FABRICATION AND ASSEMBLY

The WORF will be fabricated and assembled in the contractor's facilities located at MSFC.

WORF component/assembly cleanliness requirements will be per ISS requirements and documented in the WORF Prime Item Development Specifications (PIDS).

6.5 PHYSICAL INTEGRATION AND FUNCTIONAL CHECKOUT

The contractor's personnel will perform the physical integration and checkout of the WORF subsystems and secondary structure into the International Standard Payload Rack (ISPR) according to project PIDS requirements.

6.6 VERIFICATION

The WORF verification program will be developed to ensure that fully certified and accepted WORF end items are delivered which meet functional performance, safety and interface requirements. Interface verification requirements are derived from the ISS Payload Verification Program Plan (PVPP) SSP 52001, Pressurized Payload Interface Requirement Document (IRD), SSP 57000, the Pressurized Payloads Hardware ICD Template, SSP 57001, and the Rack unique Payload Integration Agreement.

The MSFC Flight Software Group performed an analysis to determine if IV&V should be performed on WORF Rack software. The results of this analysis indicated that neither an independent assessment nor an IV&V are required.

WORF hardware verification methods include test, inspection and analysis applied singularly or in combination. These methods are specified in the end item B1 Specifications. (Reference WORF Requirements Flow, Figure 6.1-1)

Verification reports will be developed which will describe the action taken to satisfy the verification requirements and will provide conclusions and an assessment of the degree to which the requirements were satisfied.

Upon completion of the WORF development verifications and audits, the contractor will provide, as part of the acceptance process, a properly endorsed statement that certifies the satisfaction of approved verification requirements for the deliverable end item, for interface, safety, and performance. The certification process and the accompanying Certificate of Flight Worthiness are defined in the NAS8-50000 contract.

6.6.1 TESTING

Qualification units and associated qualification level tests will be performed for each major WORF avionics component. Individual acceptance tests will be performed on each flight component. Environmental and system testing of the assembled rack will be performed to address interface, safety, and performance requirements. All testing will be in accordance with the applicable PIDS specification. (Avionics qualification testing was performed by the EXPRESS Rack Project.)

A test to verify the handshake capability of the WORF Interface Controller communication software and the ISS Payload MDM system will be performed using an ISS provided Payload Rack Checkout Unit (PRCU) prior to delivery of the WORF.

6.6.2 INTEGRATED RACK VERIFICATION

Once the end item development and acceptance process is complete, the WORF Engineering Integration (EI) team is responsible for the integrated rack (payloads and rack) verification process. The Integrated Rack requirements flow down to Sub-rack payload developers using the WORF PIH, which includes the WORF PAH, IDD, PDL Data Sets and PVP. This ensures that data needed for integrated rack verification is identified and requested from the payload developers. The WORF Generic Payload Verification Plan (GPVP) defines a generic set of verification requirements in the form of Verification Requirements Definition Sheets (VRDS). These requirements are associated with each individual requirement contained in the WORF IDD.

In the implementation phase, the Sub-rack payloads must execute their payload-unique PVP by performing/documenting/archiving the required analyses,

inspections and tests. Also, some of the results must be provided to the EI team to support integrated analyses.

6.7 POST-SHIP CHECKOUT AND INTEGRATION ACTIVITIES AT KSC

Ground processing is performed at KSC in preparation for launch. Ground processing consists of both online and offline activities for WORF and the Payloads.

Payload processing offline is the responsibility of the Payload Developers.

The WORF Team performs the WORF offline processing. The post-ship checkout of the WORF will be performed offline by the contractor using project and ISS provided hardware.

Final checkout/servicing of WORF will occur during the online processing by KSC, in accordance with requirements defined by WORF Engineering Integration. The WORF Project will provide technical support to KSC during online processing, as needed.

6.8 OPERATIONS AND TRAINING

The WORF Project will develop the engineering inputs and products necessary to train the crew and operate WORF. This includes:

- Nominal and malfunction operational procedure inputs for the WORF
- Payload Planning inputs
- WORF Trainers (Simulator per the guidelines in SSP 50323, Payload Users Development Guide, and requirements specified in the PSRD)
- Briefing material and technical support for crew training will be provided as required

The Payload Operations Integration Function Team at MSFC is responsible for: 1) final development of the flight procedures; 2) coordinating crew training on the rack; and 3) performing Real Time rack operations. The WORF Engineering Integration Team will provide on-call technical support.

Mission support will be from the Payload Operations Integration Center (POIC) at MSFC.

6.9 LESSONS LEARNED

Post increment lessons learned will be supplied to the ISS in accordance with Space Station Program Requirements for Payloads, SSP50431.

6.10 PROBLEM REPORTING AND CORRECTIVE ACTION (PRACA) SYSTEM

The project will implement a closed loop system for reporting and correcting problems that meets the intent of SSP 30223, Problem Reporting and Corrective Action System for the Space Station Program. All problems with flight hardware, flight software and Ground Support Equipment (GSE) will be included in this reporting system.

In accordance with the U.S. Government's single process initiative, the contractors reporting processes and tracking systems will be used to the extent practical. Prior to the initiation of rack level testing, closed loop problem reporting will be performed in accordance with the contractor's processes. These involve the use of Unexplained Event Reports (UER), which are loaded into the Boeing BORIS system. NASA will participate in this process in accordance with the MRB process described in section 6.3.1. (Note: Boeing standard practice is to report to the Orbital Replacement Unit (ORU) for flight, proto-flight, and flight spares, to Line Replacement Unit (LRU) on GSE, and to Shop Replacement Unit (SRU) (piece-part) for adverse trends). The Boeing BORIS system is accessible by the ISS Program Office at JSC and the PAC at MSFC.

At the initiation of rack level testing, PRACA reports will be generated (Contractor format acceptable). A copy of each report shall be submitted to the MSFC Problem Assessment Center (PAC).

Under the existing contract, reportable problems are:

a. Failures of Criticality 1, 1R, 2, 2R, and functional Criticality 3 hardware including conditions that result in Operating Maintenance Requirements Specification Documentation (OMRSD) waivers

b. Unexplained hardware anomalies, and/or

c. Over-stress or potential over-stress of hardware, detected during acceptance testing and subsequent operations, involving flight hardware

Updated reports are required until satisfactory close-out/explanation occurs.

All significant problems, whether tracked in the contractor's or NASA problem reporting system, will be entered into the ISS Risk Database as necessary. (Reference Section 12.0)

6.11 EXPORT CONTROL

Export of hardware, software and data will be performed in accordance with MSFC centerwide work instruction MWI 2190.1, MSFC Export Control Program.

6.12 SAFETY, MISSION, AND PERFORMANCE ASSURANCE

6.12.1 RELIABILITY AND MAINTAINABILITY

The WORF Project Reliability/Maintainability program has been established in accordance with NHB 5300.4 (1A-1) and NHB 5300.4 (1E). This program is documented in the contractor's Payload Science and Utilization Safety and Mission Assurance Plan (D683-35255-1), which is approved by NASA. Unique and/or specific system reliability/maintainability requirements shall be defined in end-item design specifications, as required.

ALERTS will be reviewed for impact to the flight hardware in accordance with MWI 1280.5.

6.12.2 QUALITY ASSURANCE

WORF Project will be responsive to NHB 5300.4 (1B), "Quality Program Provisions for Aeronautical and Space System Contractors". The plans for Quality Assurance for the WORF are contained in the FD31-QAPLAN-01, MSFC Space Station Multi-use Payloads Group Quality Plan.

6.12.3 SAFETY

The WORF Project will be responsible for the safety certification of basic WORF Rack and the safety certification of the integrated (payloads + rack) WORF. MSFC S&MA assessed the WORF Project and determined that a Fault Tree Analysis was not required.

WORF flight safety activities will be designed to meet the requirements of NSTS 1700.7B, NSTS 1700.7B Addendum B and NSTS 18798B. Ground safety requirements shall be implemented in accordance with KHB 1700.7B.

The WORF Project will conduct hazard analyses activities as required to provide timely identification, evaluation and control of hazardous conditions associated with WORF flight and ground hardware, including all phases of flight and ground integration.

The WORF Project will participate in phased flight safety reviews including the MSFC Safety Board. This support will include presentation of safety assessments to the Payload Safety Review Panel (PSRP) at JSC. The process

is defined in NSTS 13830. The following flight safety reviews will be conducted as a minimum:

Phase 0/I (waived by PSRP)

Phase II (January 2001)

Phase III (after fabrication and testing are complete and prior to hardware delivery)

Integrated Rack Phase III (prior to WORF Payload launch and on orbit integration)

After the Phase III review, a Safety Verification Tracking Log will be maintained as required by NSTS 13830B.

The Multi-use Payloads Group will provide input to the Launch Package Ground Safety Data Package and support the reviews at KSC as required.

7.0 PROCUREMENT SUMMARY

The WORF Project will be implemented through the MSFC managed NAS8-50000 contract, with the Boeing Defense and Space Group. The NAS8-50000 contract is a broad-based contract used by MSFC to implement its ISS utilization activities, which include operations, tactical planning, hardware development, and payload integration activities. WORF Development, Integration, and Operations will be implemented through Schedule E of this contract.

8.0 WORK BREAKDOWN STRUCTURE (WBS) AND SCHEDULES

8.1 WORK BREAKDOWN STRUCTURE (WBS)

The project will utilize a WBS structure to sequence, schedule, and track work. The WBS format and level for each end item will be defined in the NAS8-50000 contract with the Boeing Defense and Space Group. The top level WBS breakout for WORF is shown in Figure 8.1-1.

8.2 SCHEDULES

WORF Project Manager will control the project milestone schedule. The detailed schedule is assessed on a weekly basis by the project teams. On a monthly basis inputs are provided to the ISS Common Schedules Database. The top-level development schedule for the project is shown in Figure 5.2-1.

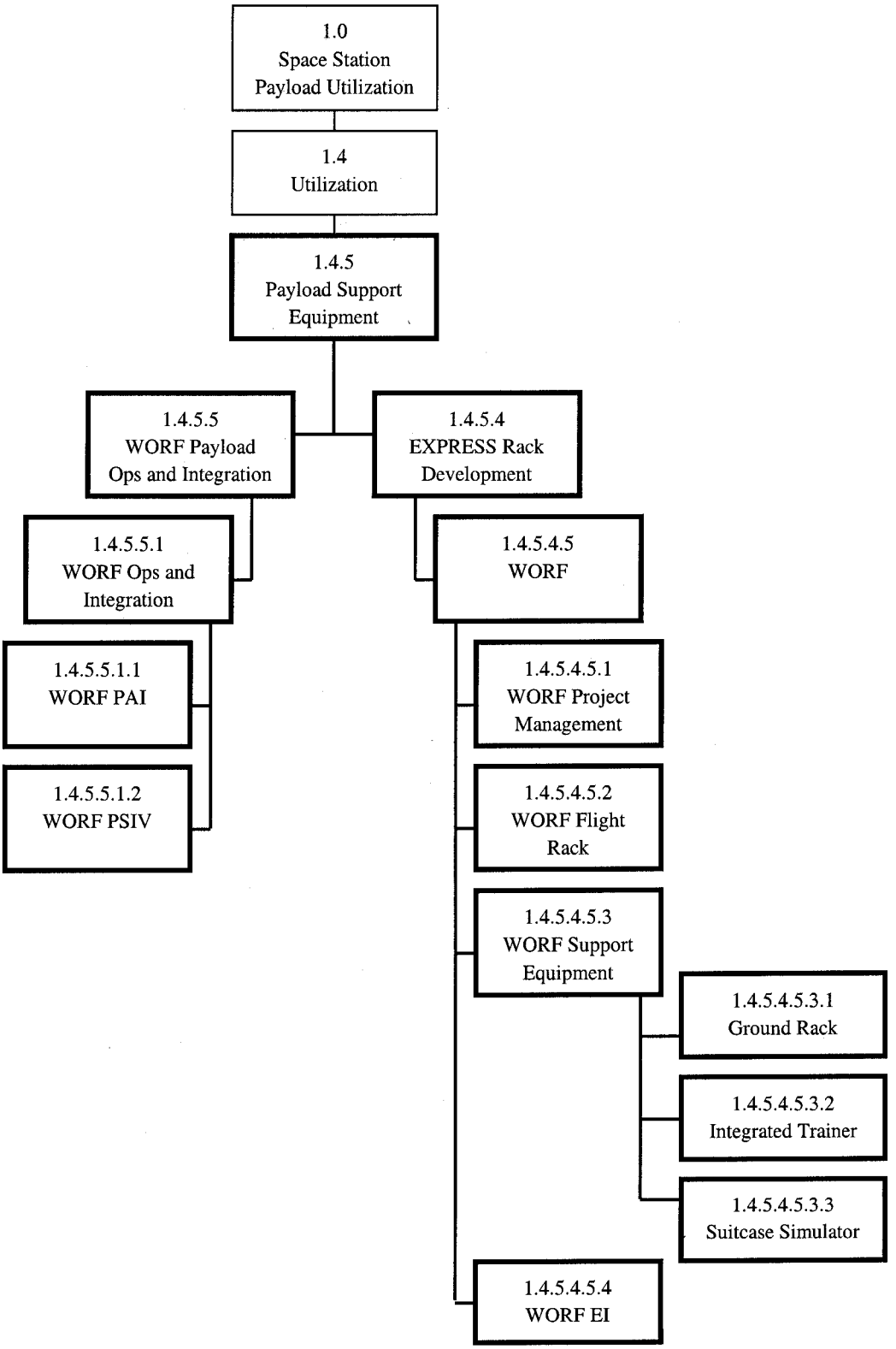


FIGURE 8.1-1 WORF WBS

9.0 RESOURCES

9.1 PROJECT FUNDING

The WORF resources are approved annually by the SSPO in JSC Internal Task Agreements (ITA), in accordance with FPD-OI-FD30.1, Payload Operations and Integration Department FD30, Management Process. The ITA will project the annual development activity, products anticipated, budget phasing, resource requirements, and other pertinent information for the current fiscal year. The current total projected cost summary for the project is shown in Figure 5.2.1. The quality record for customer agreement of funding will be the annual ISS ITA.

The WORF Project Manager and the Program Planning and Control Office control project cost through the monthly tracking. Variance analyses between the plan and the actual cost and manpower projections are reported by the contractor. Budgets are updated through the Program Operating Plan activities. Budget reserves are held at the SSPO.

The civil service manpower levels are assessed periodically to determine the total effort expended on the project. However, this is not currently a direct charge to the WORF Project.

9.2 TECHNICAL RESOURCE ALLOCATION AND CONTROL

The agreed upon rack level resource allocations will be formally documented and controlled with the SSPO via the WORF Unique Payload Integration Agreement (PIA) and the Interface Control Document (ICD). The resource allocations will be sub-allocated using a tiering approach in conjunction with the requirement flow down. (Reference Figure 6.1-1)

The physical parameters associated with the WORF will be assessed regularly to ensure that the design of the WORF does not exceed its resource allocations. The technical status of the project will be assessed routinely by the WORF team to ensure and that the performance, safety, and interface requirements are satisfied.

The following items at a minimum will be managed by the WORF Project and assessed to provide a metric for technical performance.

a. power

b. weight

c. volume

d. data

e. thermal

10.0 MANAGEMENT REVIEWS

There are several types of reviews that the WORF Project conducts or participates in (management, project, design, integration, acceptance and safety). NASA personnel chair all reviews.

10.1 PROJECT-LEVEL REVIEWS (WORF DEVELOPMENT)

The WORF Team review milestones include a System Requirements Review, Preliminary Design Review (PDR), a Final Process Review (FPR), and a Functional Configuration Audit/Physical Configuration Audit (FCA/PCA). The FPR is very similar to the traditional Critical Design Review in the data package material presented. These reviews are chaired by NASA.

10.1.1 SYSTEM REQUIREMENTS REVIEW (SRR)

The purpose of the SRR is to review end item specifications derived from top-level user requirements, interface definition and control documents, and specifications. In addition, the SRR will update project requirements to reflect user inputs, programmatic decisions and changes resulting from contract negotiations. Successful completion of the SRR freezes project requirements. Data is reviewed jointly by Boeing, NASA, and potential users.

10.1.2 PRELIMINARY DESIGN REVIEW (PDR)

The purpose of the PDR will be to provide a technical review of the basic design approach and to ensure compatibility with the system requirements including interface requirements. The PDR is held at the system, subsystem, and component level to demonstrate that the design meets system requirements with acceptable risk. The basic objectives are: assurance that system requirements have been allocated to the subsystem and component level; design will meet performance and functional requirements and evidence that the design is verifiable and will not pose major cost overruns or schedule delays. Issues not resolved and actions identified by the team will be documented and presented at the PDR Management Review. Successful completion of the PDR results in approval of configuration items and release of preliminary drawings. A successful PDR is required prior to proceeding to the detailed design phase.

10.1.3 FINAL PROCESS REVIEW (FPR)

The purpose of the FPR will be to determine if the detailed system and subsystem design, derived from the IPR, meet performance and functional requirements and is of sufficient detail to provide for transition to manufacturing, integration and verification. The FPR will be conducted using a more structured process than the IPR, with a data package distribution, review period, comment form, and discipline teams to disposition comments. The discipline teams will consist of: Structural/Mechanical; Electrical/Power; Thermal; Software;

Data/Video; Systems; and Safety and Mission Assurance. A summary status and breakdown of comments will be presented at the FPR Management Review, along with any disapproved comments. Approved programmatic comments and open actions identified by the team will be documented and presented at the FPR Management Review. Successful completion of the FPR freezes the design and results in release of engineering drawings to manufacturing, proceeding with software coding and approving fabrication, qualification and test requirements and plans.

10.1.4 FUNCTIONAL CONFIGURATION AUDIT (FCA)/PHYSICAL CONFIGURATION AUDIT (PCA)

The purpose of the FCA/PCA is to certify the design and to evaluate the results and status of the verification, testing, and analysis of the configuration item. It will verify that the "as built" configuration correlates with the "as designed" configuration. The FCA/PCA Process is defined in D684-10097-01.

10.2 PROGRAM-LEVEL REVIEWS

10.2.1 PAYLOAD READINESS REVIEW (PRR)

The purpose of the Payload Readiness Review is to indicate the readiness of the EI team to proceed with the integration of the subrack mounted payloads with the rack. The PRR is held approximately at L-11 months. Successful completion of the PRR confirms payload readiness for the ISSP Flight Readiness Review. Data is reviewed jointly by the project and the SSPO.

10.2.2 FLIGHT READINESS REVIEWS

The purpose of the Flight Readiness Review will be to provide certification that all activities required for flight have been successfully completed and any open items remaining have been properly identified and planned for closure. Participation of the developers in the FRR process is in accordance with the ISS Payloads Certification of Flight Readiness (CoFR) Implementation Plan, SSP 52054.

10.2.3 MONTHLY STATUS REVIEW

Program-level reviews are held periodically between the WORF Project and the SSPO. These reviews discuss the past month's cost (actual vs. planned), manpower usage, accomplishments, plans, schedule status and issues.

10.2.4 INDEPENDENT ANNUAL REVIEWS (IAR)

The WORF Project will support Independent Annual Reviews as requested by the ISS Program or GPMC, in accordance with MPG 7120.1.

10.3 CONTRACTOR REVIEWS

The contractor will conduct a monthly review with the WORF Team to report status, metrics, issues and plans for the following month.

Contractor performance evaluation activities will be conducted semi-annually by the MSFC Payload Operations and Integration Department. The areas of evaluation are: project management, technical, cost, and S&MA. Based on this evaluation, the amount of award fee is granted to the contractor by the Performance Evaluation Board. This board is composed of MSFC management.

11.0 RISK MANAGEMENT

The WORF Project will manage risk in accordance with MSFC-PLAN-3101, Pressurized Payloads Team Risk Management Plan.

Project risks will first be assessed on a qualitative level and where feasible/practical the project risks will be quantified in terms of cost and/or schedule impacts, as well as technical impacts. The WORF Project will conduct trade studies and develop mitigation plans that will be used to identify potential risk reduction actions as needed

Major project risks will be entered into the ISS Risk Management Database as agreed to by the SSPO.

12.0 ENVIRONMENTAL IMPACT

N/A

13.0 WORF HARDWARE AND SOFTWARE SECURITY

The security of the WORF hardware will be maintained throughout all phases of the WORF Project. The flight systems shall be kept in a location where it will not be accessible to the general public. It shall be kept in a location that is secure during off-duty hours and holidays.

During fabrication, assembly and hardware integration of the WORF, the contractor will be responsible for maintaining the security of the hardware.

The WORF flight and ground test systems software code configuration control shall be maintained by the contractor.

14.0 LOGISTICS AND MAINTENANCE

The Pressurized Payloads Team of the Multi-use Payloads Group is responsible for the logistics and maintenance and sustaining engineering activity for WORF. This includes an integrated logistics and maintenance analysis and spares procurement for the WORF. The logistics tasks will be planned to meet the intent of SSP 50277 Payloads Logistics and Maintenance Plan. The rack designs will utilize common hardware to the extent practical. Components within the WORF are to be replaced on-orbit at the box level. The failed unit will be returned to the ground, repaired and placed back into spares inventory. The sustaining engineering effort will provide limited engineering support to maintain the WORF design during the operations phase.

15.0 GOVERNMENT FURNISHED EQUIPMENT (GFE)

A number of items used in the buildup of the WORF are being provided to the project as GFE. An International Standard Payload Racks (ISPR) is to be provided to the WORF Project to be used in rack buildup. The Standard Payload Outfitting Equipment (SPOE) is developed by the ISS program and provided for use in payload development. These items will be delivered to the WORF Program as GFE. The SPOE items, associated quantities, and delivery dates are documented in Appendix B.

APPENDIX A: ACRONYM AND ABBREVIATIONS LIST

ACRONYM AND ABBREVIATIONS LIST

A	Amps
AAA	Avionics Air Assembly
ADP	Acceptance Data Package
AI	Altered Item
AIT	Analysis and Integration Team
ARIS	Active Rack Isolation System
C&DH	Command and Data Handling
CCB	Configuration Control Board
CDR	Critical Design Review
CoFR	Certification of Flight Readiness
COTR	Contracting Officer's Technical Representative
CSD	Common Schedules Database
CVIC	Common Video Interface Card
CVIU	Common Video Interface Unit
DAR	Deviation Approval Request
DC	Direct Current
ECLSS	Environmental Control & Life Support System
ECR	Engineering Change Request
EEE	Electrical, Electronic, & Electromechanical
ED	Engineering Directorate
EI	Engineering Integration
EXPRESS	EXpedite the PRocessing of Experiments to Space Station
FCA	Functional Configuration Audit
FCU	Functional Checkout Unit
FMEAs	Failure Modes Effects Analyses
FPR	Final Process Review
FTE	Full Time Equivalent
GFE	Government Furnished Equipment
GPMC	Governing Project Management Council
GSE	Ground Support Equipment
HHR	Habitat Holding Rack
HOSC	Huntsville Operations Support Center
HRF	Human Research Facility
ICD	Interface Control Document
IDD	Interface Definition Document
IDRD	In-House Data Requirements Document
IPR	Interim Process Review
IRD	Interface Requirements Document
ISIS	International Subrack Interface Standard
ISPR	International Standard Payload Rack
ISS	International Space Station
ITA	Internal Task Agreement
JSC	Johnson Space Center
KSC	Kennedy Space Center
LRU	Line Replacement Unit

LSA	Logistics Support Analysis
LSE	Laboratory Support Equipment
MPLM	Multi-use-Pressurized Logistics Module
MRB	Material Review Board
MSFC	Marshall Space Flight Center
MSL-1	Microgravity Sciences Lab - One
NASA	National Aeronautics and Space Administration
NHB	NASA Handbook
NOA	New Obligation Authority
NSTS	National Space Transportation System
NTSC	National Television Systems Committee
OMRSD	Operating Maintenance Requirements Specification Documentation
ORU	Orbital Replacement Unit
PAC	Problem Assessment Center
PCA	Physical Configuration Audit
PCH	Program Critical Hardware
PIDS	Prime Item Development Specification
POIC	Payload Operations Integration Center
POIF	Payload Operations Integration Function
PRACA	Problem Reporting and Corrective Action
PRCU	Payload Rack Checkout Unit
PRR	Payload Readiness Review
PSRD	Payload Simulator Requirements Document
PSRP	Payload Safety Review Panel
PTC	Payload Training Capability
PU	Panel Unit
PVP	Payload Verification Plan
RIC	Rack Interface Controller
SCDP	Safety Compliance Data Package
ScS	Suitcase Simulator
SIR	Standard Interface Rack
SPOE	Standard Payload Outfitting Equipment
SRR	System Requirements Review
SRU	Shop Replacement Unit
SS	Space Station
SSBRP	Space Station Biological Research Project
SSPCM	Solid State Power Control Module
SSPO	Space Station Payloads Office
SSTF	Space Station Training Facility
STS	Space Transportation System
SVMF	Space Vehicle Mock-up Facility
UER	Unexplained Event Record
V	Volts
VRDS	Verification Requirements Definition Sheets
W	Watts
WBS	Work Breakdown Structure
WORF	Window Observational Research Facility

WPIM	WORF Payload Integration Manager

APPENDIX B: PROGRAM FURNISHED EQUIPMENT REQUIREMENTS

B.1 Program Furnished Equipment Requirements

Table B.1-1, identifies the Program Furnished Equipment Requirements for the WORF Project. These items shall be supplied by SSPO. The columns of the table are detailed below.

A. Part #: The part number for the Equipment Item

B. Equipment Item: The Program Furnished Equipment hardware required. (Unless specifically designated as Ground Support Equipment (GSE), the hardware will be used for Flight)

C. Quantity (Qty): The quantity of each equipment item to be supplied

D. Need Date: The calendar date by which the equipment must be on-dock at MSFC.

TABLE B.1-1: PROGRAM FURNISHED EQUIPMENT REQUIREMENTS

Part Number	Nomenclature	Required For	Quantity	Unit	Fidelity	Need Date
220G07505-001	Rack Shipping Container	Flight Rack	1	EA	FLT	5/1/01
220G07470-001	MSFC Base	Flight Rack	1	EA	FLT	8/1/00
220G07455-001	Upper Structural Assembly	Flight Rack	1	EA	FLT	8/1/00
220S9000-001	Starboard Crossover Structure Attach Brackets Kit	Flight Rack	1	EA	FLT	8/1/00
220S09001-001	Port Crossover Structure Attach Brackets Kit	Flight Rack	1	EA	FLT	8/1/00
683-50199-2	WORF ISPR Outfitting Kit	Flight Rack	1	EA	FLT	8/30/00
683-50243-4	ISPR-4	Flight Rack	1	EA	FLT	1/15/00
683-61664-11	ARIS Lower Snubber Assy Left	Flight Rack	1	EA	FLT	5/1/01
683-61664-12	ARIS Lower Snubber Assy Right	Flight Rack	1	EA	FLT	5/1/01
683-61664-15	ARIS Lower Snubber Cup Left	Flight Rack	1	EA	FLT	5/1/01
683-61664-16	ARIS Lower Snubber Cup Right	Flight Rack	1	EA	FLT	5/1/01
1J00045-1	Snubber Cup Insert Lower Right	Flight Rack	1	EA	FLT	5/1/01
1J00045-2	Snubber Cup Insert Lower Left	Flight Rack	1	EA	FLT	5/1/01
683-50249-2	Knee Brace	Flight Rack	1	EA	FLT	5/1/01
SED33108703-3XX	PGSC Desk	Flight Rack	1	EA	FLT	5/1/01
SEG33107631-3XX	Bracket Assy, Multi-Use	Flight Rack	1	EA	FLT	5/1/01
SDZ39129262-3XX	Laptop Assembly w/ mods	Flight/Trainer Racks	2	EA	FLT	5/1/01
SED39126010-3XX	PGSC Power Supply	Flight/Trainer Racks	2	EA	FLT	5/1/01
SEG39129263-3XX	20V Power Cable	Flight/Trainer Racks	2	EA	FLT	5/1/01
SEG39129264-3XX	28V Power Cable	Flight/Trainer Racks	2	EA	FLT	5/1/01
7254023-004	High Fidelity 6 Post Rack	Trainer Rack	1	EA	GSE	11/1/00

7254064-001	Castored Pallet	Trainer Rack	1	EA	GSE	11/1/00
7256174-001	Shipping Crate w/ Upper	Trainer Rack	1	EA	GSE	11/1/00
7306505-001	Payload Simulator	Trainer Rack	1	EA	GSE	3/1/00
7306505-003	Signal Conditioning Equipment	Trainer Rack	1	EA	GSE	3/1/00
C++ License	S/W C++ License	Trainer Rack	1	EA	GSE	3/1/00
G2 License	S/W G2 License	Trainer Rack	1	EA	GSE	3/1/00
683-14053-1	EDA Rack	Ground Rack	1	EA	GSE	10/3/99

Notes:
1. Table B.1-1 contains the non-increment specific PFE requirements for the entire WORF program.

APPENDIX C: PRP REQUIREMENT CROSS REFERENCE MATRIX

C.1 PRP REQUIREMENT TO COMPLIANCE CROSS-REFERENCE MATRIX

Table C.1-1, identifies the WORF Project compliance with the requirements of SSP 50431 Space Station Program Requirements for Payloads.

TABLE C.1-1: PRP REQUIREMENT CROSS-REFERENCE MATRIX

Section	Requirement Title		Compliance
4.0	Program Requirements	A	- Comply with intent. See below
4.1	Technical Requirements	-----	-
4.1.1	Payload Classification	A	- Comply with intent. See Section 1.1
4.1.1.1	Facility Payload	A	- See Section 1.1
4.1.1.2	Complex Subrack/Subpallet Payload	N/A	
4.1.1.3	Subrack/Subpallet Payload	N/A	
4.1.2	Reliability, Maintainability and Quality Assurance (RM&QA) Plan	A	Approved RM&QA Plan by MSFC D683-35255-1 (Payload Science and Utilization & Mission Assurance Plan)
4.1.2.1	Reliability	A	Items exist but in separate reports.
	(1) Reliability Assessment	A	D683-35261-1 (Reliability/Maintainability Analysis)
	(2) Burn-in Time Statement	A	S683-34527 (8/2 PIDS)
	(3) Failure Modes and Effects Analysis/Critical Items List (FMEA/CIL)	A	D683-35260-1 (Payload Science & Utilization Failure Modes and Effects Analysis/Critical Items List)
	(4) Single Point Failures List	A	D683-35260-1 (Payload Science & Utilization Failure Modes and Effects Analysis/Critical Items List)
	(5) Failure Propagation Assessment	A	D683-35260-1 (Payload Science & Utilization Failure Modes and Effects Analysis/Critical Items List)
	(6) NASA Advisories	A	D683-2000-XX (Payload Science and Utilization ALERT Report)
	(7) Fault Detection, Isolation and Recovery	A	D683-35261-1 (Reliability/Maintainability Analysis)
4.1.2.2	Maintainability	A	D683-35261-1 (Reliability/Maintainability Analysis)
4.1.2.3	Electrical, Electronic, and Electromechanical (EEE) Parts	A	D683-35257-1 (Science and Utilization Electrical, Electronic, and Electromechanical Parts Control Program Plan)

4.1.2.4	Quality Assurance (QA)	A	Comply with intent. FD31-QAPLAN-01 (MSFC Space Station Multi-use Payloads Group Quality Plan) Complies with NHB 5300.4
4.1.2.4.1	Procurement Documentation	A	FD31-QAPLAN-01 (MSFC Space Station Multi-use Payloads Group Quality Plan)
4.1.2.4.2	Material Identification	A	FD31-QAPLAN-01 (MSFC Space Station Multi-use Payloads Group Quality Plan)
4.1.2.4.3	Workmanship Standards	A	FD31-QAPLAN-01 (MSFC Space Station Multi-use Payloads Group Quality Plan)
4.1.2.4.4	Stamps	A	FD31-QAPLAN-01 (MSFC Space Station Multi-use Payloads Group Quality Plan)
4.1.2.4.5	Metrology		
4.1.2.4.6	Nonconformance	A	FD31-QAPLAN-01 (MSFC Space Station Multi-use Payloads Group Quality Plan)
4.1.2.4.7	Software Quality Assurance	A	FD31-QAPLAN-01 (MSFC Space Station Multi-use Payloads Group Quality Plan)
4.1.2.4.8	Problem Reporting and Corrective Action (PRACA) System	E	See Section 6.10
4.1.3	Logistics	A	Integrated Logistics Support Plan, ORU Listing, Logistics Support Analysis Record, Preflight Imagery Plan under development
4.1.4	Payload Integration Agreement	A	
4.1.5	Compatibility with Multiple ISS Elements	E	Rack is custom built for the U.S. Lab window position
4.1.5.1	Standard Interfaces	A	- WORF designed for standard interfaces including 3/6/12kw positions
4.1.5.2	Standard Interface Options	A	
4.1.5.3	Module Specific Interfaces	A	U.S. Lab Window
4.1.6	System Specification / Functional Requirements Document	A	S683-83660 Functional requirement were flowed from the WORF PRD into the PIDS- See section 6.1
4.1.7	Sustaining Engineering	A	
4.1.8	Payloads Hardware/Software Acceptance and Certification Process and Requirements	A	
4.1.9	Training	A	Delivery of Trainer to JSC
4.1.10	Common Hardware	A	See Appendix B
4.1.11	LSE	A	Light, Portable Fan
4.1.12	Middeck Lockers	N/A	
4.2	Management Requirements	A	-

4.2.1	Requirements Flow Down	A	S683-83660 Functional requirement were flowed from the ISS and WORF PRD into the PIDS- See section 6.1
4.2.2	Risk Management	A	Controlled per Rack Plan ERO-QR-4
4.2.3	Project Level Reviews	A	Release of negotiated products in Data Products List, See Appendix D
4.2.4	Documentation – Management		
4.2.4.1	Mission Evaluation Request	N/A	Submission of MER at L-5 years, updated annually
4.2.4.2	Project Plan	A	Baselined Project Plan
4.2.4.3	Joint Implementation Plan (JIP)	N/A	Baselined Joint Implementation Plan
4.2.5	Configuration Management	A	MSFC-PLAN-3028 (MSFC Space Station Multi-use Payloads Group Configuration Plan
4.2.6	Export Control	E	Export Control performed in accordance with Section 6.11

APPENDIX D: PAYLOAD DEVELOPMENT DATA PRODUCTS LIST

D.1 PAYLOAD DEVELOPMENT DATA PRODUCTS LIST

Table D.1-1, identifies the major data products for the initial development (first flight) of the ARIS and nonARIS WORFs, in compliance with the requirements of SSP 50431 Space Station Program Requirements for Payloads. This list has been tailored for applicability based upon the data products and development schedule of the WORF Project.

TABLE D.1-1 PAYLOAD DEVELOPMENT DATA PRODUCTS LIST

No.		TITLE	SRR	PDR	FPR	SAR	PRR	FRR
		PLANS & REQUIREMENTS						
1	√	Acceptance Data Package/IDP Supplement (Ref. SSP 30695, ADP, Ref. SSP 52000-PDS for IDP Supplement)				F	U	U
2		Acceptance Plan		P	F			
3		Acceptance Test Report				F		
4	√	Acoustics Control Plan			F			
5		Applicable Standards List	P	F				
6		Build-To Specification (Level C)(WORF has PIDS)		P	F			
7	√	Certification of Flight/Launch Readiness						F
8		Command and Control Plan (WORF Operations Manual)			P	F		
9		Configuration Management Plan	P	F				
10		Cost and Schedule Report		P	F			
11		Data Management Plan						F
12		Design Analysis Reports(90%)		P	F			
13		Design Data Package(90%)		P	C			
14		Drawing Tree/Engineering Drawing List (90%)		P	C			
15		Electrical, Thermal, C&DH Drawings/Schematics (90%)		P	C			
16	√	Electromagnetic Interference/Compatibility Plan			F			
17		Engineering Master Plan/Master Schedule	P	F				
18	√	FMEA (Failure Mode & Effects Analysis)		P	F			
19	√	Fracture Control Plan		P	F			
20	√	Fracture Control Summary Report			P	F		
21	N/A	Ground Processing Plan						
22	N/A	Ground Processing Plan						
23	√	Hardware Interface Control Document			F		U	
24	√	Integrated Logistics Support Plan			P			F
25		Integrated Schematics			P		F	
26	√	Interface Requirements					F	
27	N/A	Launch Site Safety Plan (* Per KHB 1700.7)						
28	N/A	Lesson Plan (only if performing crew training)						
29		Life Cycle Cost Estimates (at Project Proposal)						
30	√	Limited Life List			F			

No.		TITLE	SRR	PDR	FPR	SAR	PRR	FRR
		PLANS & REQUIREMENTS						
31	√	Listing of All Payload Rack Protrusions					P	F
32		Logistics Support Analysis Record					P	F
33		Materials and Processes Control Plan		P	F			
34		Materials Usage Agreements		P		F		
35	√	Microgravity Control Plan						P
36		On-Orbit Configuration Drawings (including definition of unique protrusions)					P	F
37		Operations Plan		P		F		
38		Operations Procedures				P	F	
39		Parts List (includes critical ORUs)		P		F		
40	√	Payload Development Schedule	P	C	U	U	U	U
41	√	Payload Integration Agreement		P	F		U	
42	√	Payload Integration Agreement Data Sets			P		F	
43	√	Payload Integration Agreement Addenda's			C		U	
44	√	Payload Integration Management Schedule	P	C	U	U	U	U
45	√	Payload Unique Verification Plan - Design		P	F		U	
46	√	Payload Verification Plan (PVP) - Interface			P	F	U	
47		Phase 1 Flight Safety Review (Ground/Flight)		C				
48		Phase 2 Flight Safety Review (Ground/Flight)			C			
49		Phase 3 Flight Safety Review (Ground/Flight)				C		
50	√	Preflight Imagery Plan (Performed on follow-on racks)					P	F
51	√	Project Management Plan	P	F				
52	√	PVP Waivers Submit						C
53		Qualification Test Report				F		
54		Reliability Report		P	F			
55	√	Reliability, Maintainability and Quality Assurance Plans		P	F			
56		Risk Analysis				F		
57		Risk Management Plan					P	F
58		Safety Analysis Report		P		F		
59	N/A	Security Plan						
60	√	Software Interface Control Document			P	F	U	
61		Specification Tree		P	F			
62	√	Systems Specification/Functional Requirements Document		P	F			
63		Technical Performance Measurement Plan		P	F			
64		Technical Performance Measures Report		P	F			
65		Technical Task Agreement (Per POP Cycle)						
66		Test Plans		P	F			
67	√	Trainer Development Specification		P	F			
68		Training Plan		P	F			
69		Work Breakdown Structure (at Project Proposal)						

√ - Denotes those products that are mandatory for Facility Payloads

SRDR - System Requirements Review
PDR - Preliminary Design Review
CDR - Critical Design Review
IPR - Initial Process Review
FPR - Final Process Review
N/A - Not Applicable to WORF
SAR - System Acceptance Review
PIRR - Payload Readiness Review
FRR - Flight Readiness Review

P - Preliminary
C - Completed
U - Updated
S - Status
F - Final